DOCUMENT RESUME

ED 201 580 SO 013 340

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TITLE How to Study: The Neglected Basic.
PUB DATE Jan 79
NOTE 19p.; Paper presented at Brigham Young University Midyear Conference (Provo, UT, January 1979).

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Comprehension; *Educational Needs; Memorization; Methods; Problem Solving; Secondary Education; Study Guides; *Study Skills; Visualization

ABSTRACT

This paper examines knowledge of studying--knowing how and when to apply study strategies. Study strategies may be classified into three categories: memory strategies, comprehension strategies, and problem-solving strategies. Memory-study strategies help students remember what they study. Five attributes often characterize memory strategies: meaningfulness, organization, association, visualization, and attention. Some memory strategies include rhymes, patterns, acronyms, acrostics, the link system, the loci system, and the peg system. Comprehension strategies help students understand what they study. Activities in comprehension strategies include identifying important information (e.g., underlining main ideas or taking note of headings); paraphrasing and summarizing important information; generating examples and questions; outlining; reorganizing notes; and elaborating. One of the most well-known comprehension strategies is Francis Robinson's SQ3R method. Problem-solving study strategies help students solve problems, innovate, and invent. A number of writers have offered techniques for solving problems. However, a sound rationale underlying the processes of problem solving has not yet emerged. Strategies that are especially useful for solving well-defined problems usually focus on two activities: generating plausible alternative solutions and systematically testing these proposed solutions. (Author/RM)

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How to Study: The Neglected Basic

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Presented at the Brigham Young University

Midyear Conference

Provo, Utah

January, 1979

SP 013 340

Abstract

The back to the basics movement typically has emphasized the three R's. Indeed, knowledge of reading, writing, and performing mathematical operations is fundamental to learning in many subject matter areas. However, another type of crucial and basic knowledge, which seldom is directly taught, is knowledge of studying. Knowledge of studying is knowing how and when to apply study strategies. A study strategy is a particular set of learning behaviors under the consceious control of the learner. Many learning differences that often are attributed to differences in natural abilities perhaps may be better attributed to differences in knowledge of studying. Greater knowledge of studying leads to better learning partly because it enhances a student's ability to adapt to various instructional treatments. Knowledge of studying usually is slowly and haphazardly inferred from learning experiences. We believe that knowledge of studying would be more speedily and systematically acquired if it were directly taught to students.

HOW TO STUDY, THE NEGLECTED BASIC

Give a man a fish and you feed him for a day.
Teach a man how to catch a fish and you feed him for a lifetime.

The recent surge of concern for returning to the basics is refreshing because it renews our awareness that certain types of underlying knowledge enable students to feed themselves all types of knowledge.

The back to the basics movement typically has emphasized the three R's. Indeed, knowledge of reading, writing, and performing mathematical operations is fundamental to learning in many subject matter areas. However, another type of crucial and basic knowledge which seldom is directly taught is knowledge of studying.

Knowledge of studying is knowing how and when to apply study strategies. A study strategy is a particular set of learning behaviors under the conscious control of the learner. Study strategies may be classified into three categories. Memory study strategies help students remember what they study. Comprehension strategies help students understand what they study. Problem solving study strategies help students solve problems, innovate, and invent.

Memory Strategies

In his book Your Memory, How It Works and How To Improve It, Kenneth Higbee identifies five attributes which often characterize memory strategies.

Meaningfulness. Memory strategies help make the information to be remembered meaningful. The more meaningful information is, the better it is remembered. For example, nonsense words are more difficult to remember than real words.

Organization. Memory strategies provide a systematic way to record and retrieve the information to be remembered. In general, the more organized

information is at the time of recording, the easier it is to retrieve. For instance, a list of words arranged in random order is more difficult to remember than the same list of words organized into categories.

Association. Memory strategies relate the information to be remembered with information that is already known. For example, you probably already know how to spell ceiling, ground, stalactite, and stalagmite. By associating ceiling with stalactite and ground with stalagmite, you will have no trouble in remembering that stalactites grow from the ceiling and stalagmites grow from the ground.

Visualization. Many memory strategies involve the association of information to be remembered with visual images. Mental imagery can greatly facilitate recall. Thus, picturing in your mind the object a word stands for may assist you in remembering that word.

Attention. Memory strategies encourage concentration. Information cannot be remembered if it has never been given any conscious attention.

Some of the memory strategies described by Dr. Higbee include rhymes, patterns, acronyms, acrostics, the link system, the loci system, and the peg system. Rhymes, patterns, acronyms, and acrostics are specific-purpose memory strategies while the link, loci, and peg systems are general-purpose memory strategies. A specific-purpose memory strategy can only be used for one purpose. For example, the rhyme "Thirty days hath September, April, June and November" is great for remembering which months have thirty days, but it is not helpful for remembering the birthdays of your brothers and sisters. On the other hand, a general-purpose memory strategy can be applied to a variety of memory tasks.

Specific-Purpose Memory Strategies

Rhymes. Because rhymes are readily remembered, the information they contain is very accessible. Do you recognize these rhymes? "I before e except

after c, or when sounded as a, as in neighbor and weigh." "In 1492, Columbus sailed the ocean blue."

Patterns. Finding patterns condenses the amount of information that must be remembered. For instance, the 15-digit number 147101316192225 would be difficult to remember unless you noticed that 1+3=4, 4+3=7, 7+3=10, 10+3=13, etc.

Acronyms. Words formed from the first letters of other words can aid in remembering those other words. For example, the acronym HOMES makes it easy to remember the names of the Great Lakes. H-Huron, O-Ontario, M-Michigan, E-Erie, S-Superior.

Acrostics. Acrostics are much like acronyms. But, instead of using one word, acrostics use a series of words or phrases in which the first, last, or certain other letters act as a cue for the information to be remembered. For instance, the phrase "Every Good Boy Does Fine" can help you remember the notes on the lines of the treble clef musical scale, EGBDF.

General-Purpose Memory Strategies

Link system. There are two steps in the link system. First, create a visual image for each item in the list to be remembered. Second, associate the image for each item with the image for the next item. As an example, suppose that you were given a list containing the words *frosting*, *bed*, *astronaut*, and *applesauce*. To use the link system to remember the list, you first visually associate *frosting* and *bed*. You might imagine a bed covered with frosting. Next, you visually associate *bed* and *astronaut*. You might mentally picture an astronaut clothed in a spacesuit lying in bed. To associate *astronaut* and *applesauce*, you might visualize an astronaut removing the helmet from his spacesuit and eating from a can of applesauce.

Loci system. The loci system also consists of two steps. First, memorize a series of mental images of locations in some natural order. Second, associate a visual image of each item to be remembered with one of the memorized locations. This is done by mentally placing the first item in the first memorized location, the second item in the second location, etc. For example, in order to remember the words *trap*, *candle*, *hose*, and *engine*, you might picture each of these objects in a different location in your house. You might imagine a steel trap dangling from the door knob, a burning candle on the shelf of the coat closet, a coiled hose in the refrigerator, and a car's engine in the bathtub. Recalling the words is simply a matter of coming home (there's the trap), putting away your coat (there's the candle), going to the refrigerator for a bite to eat (there's the hose), and relieving a natural urge (there's the engine).

Peg system. The peg system is similar to the loci system. However, visual associations are made with a memorized list of concrete nouns which correspond to numbers rather than with a memorized series of locations. A widely used set of peg words is shown below.

one-bun	five-hive	eight-gate
two-shoe	six-sticks	nine-wine
three-tree	seven-heaven	ten-hen
four-door		

Suppose you wanted to remember the words *book*, *sink*, *fish*, and *report*. You might visualize a *book* between two ends of a hamburger bun, a tennis shoe in the kitchen *sink*, a *fish* caught in the crotch of a tree, and a written *report* tacked onto a door. Then, if you were asked to recall the third word in the list, you would first think of three. That would bring to mind tree which, in turn would bring to mind fish.

Comprehension Strategies

The basic principles of learning underlying memory strategies also function for comprehension strategies.

Meaningfulness. The primary purpose of comprehension strategies is to make the information to be learned meaningful. Information is not comprehended until it becomes meaningful to the learner. Comprehension strategies also serve as memory strategies because the more meaningful information is, the better it is remembered.

Organization. Comprehension strategies often assist the learner to organize the information to be understood in a way that enables him to comprehend it. For example, it is easier to comprehend a new concept when examples of that concept are grouped together and can be considered simultaneously than when examples of that concept are interspersed among other information which must also receive attention.

Association. Information to be understood only becomes meaningful as it is associated with information the learner already understands. Of course, comprehension strategies help learners relate what they do not understand to what they understand so that comprehension can take place.

Attention. Comprehension strategies, like memory strategies, encourage concentration. Information cannot be comprehended if it has never been given any conscious attention.

Activities in Comprehension Strategies

Comprehension strategies typically incorporate some subset of the following learner activities.

Identify important information - Underline main ideas. Take note of headings. Study summaries. Attend to conspicuous material.

Paraphrase and summarize important information - Summarize main ideas in your own words. Draw diagrams of relationships. Teach the material to someone else.

Generate examples and questions - Think up examples of main ideas. Develop an instance which is a debatable example of the main idea. Seek clarification for unclear critical attributes. Think of a question and read to answer it.

Outline - Arrange ideas with regard to subordinate - superordinate relationships. Order ideas in a logical fashion.

Reorganize notes - Condense notes into an outline form. Organize notes according to some general format such as 1) purpose, 2) main ideas, 3) supporting evidence, and 4) relevance to personal values.

Elaborate - Write a report which includes ideas that were taught. Apply ideas to new instances. Change and extend ideas. Evaluate ideas with regard to various criteria. Consider implications of what is taught. Compare and contrast alternative explanations.

SQ3R Method

One of the most well known comprehension strategies is Francis Robinson's SQ3R method. This method consists of five steps: Survey, Question, Read, Recite, Review.

Survey. To survey a book, read the preface, table of contents, and chapter summaries. To survey a chapter, study any overview or outline and skim the chapter paying particular attention to headings, figures, tables, and pictures. Also, reread the chapter summary.

Question. Develop questions based on what you noted during the survey step.

Read. Read the chapter without taking notes. Answer your questions. Underline important words and phrases only after your reading is completed.

Recite. Reread while asking yourself questions and answering them.

Review. At various time intervals after originally studying the chapter or book, survey it again and question yourself on it.

4-Fold Method

Walter Gong devised a comprehension strategy which is quite widely used, especially at the college level. As its name implies, this method entails four steps.

Purposes. Describe the purposes (goals, intentions, motivations, etc.) for presenting the information.

Central messages. Describe the central messages (main ideas, principles, concepts, etc.) for achieving the purposes.

Validation. Describe validations (evidences, examples, etc.) that were cited to support or refute the central messages.

Value. Describe how the information affects your beliefs (values) and society.

Problem Solving Strategies

A number of writers have offered techniques for solving problems in different domains, including education (Wickelgren, 1974; Kaufman, 1976; Bloom & Broder, 1950), interpersonal relations (Spivack & Shure, 1974), industry (Kepner & Tregoe, 1965; Davis, 1973; Gordon, 1971), and management (Margerison, 1974). Polya's popular How to Solve It includes many suggestions generally applicable to problems of many sorts.

In spite of the proliferation of techniques, however, a sound rationale underlying the processes of problem solving has not yet emerged. A great deal

theoretical work has been done by Newell and Simon (1972) and others, but their work has been limited to well-defined problems. Well-defined problems may be thought of as problems with goals already or easily defined. Puzzles are good examples of well-defined problems because the structure of the task is well-defined. A person working on a crossword puzzle will know when a solution has been reached.

Strategies that are especially useful for solving well-defined problems usually focus on two activities: generating plausible alternative solutions and systemtically testing these proposed solutions.

Solution-generating strategies. Solution-generating strategies include brainstorming (Osborn, 1963) and idea checklists. Warren and Davie (1969) used two different kinds of checklists. When faced with the task of thinking of "ways to change or improve a doorknob", students received either a short 7-item checklist or a list of 73 idea-spurring questions. The short checklist contained the following dimensions.

Add and/or subtract something.

Change color.

Change the materials.

Change by rearranging the parts.

Change shape.

Change size.

Change design or style.

This short checklist helped students generate more and better ideas than the lengthier question list.

Solution-testing strategies. Solution-testing strategies generally involve examining the proposed solution to see if it adequately achieves the desired goal. Carkhuff (1973) presents a values hierarchy in which proposed solutions are compared against prioritized values. Wickelgren (1974) advocates

a quantified decision-making approach to evaluating and comparing proposed solutions. Both of these solution-testing strategies are best applied to well-defined problems.

Ill-defined problems, on the other hand, present more difficulties for the problem-solver. The characteristics and goals of an ill-defined problem are not easily identified. Even the process of recognizing that such a problem exists is a very crucial activity. Most real-life problems probably resemble ill-defined problems. Klein and Weitzenfeld (1978) offer an example of an ill-defined problem:

> [T]he problem of reducing crime in a given area of a city may be important to all the residents of that area, and they may organize to combat crime. Such organizations will be ineffective to the extent that they cannot agree on goals. What types of crime shall they concern themselves with? If they concentrate on crimes against people, then they may lose the support of the richer and more influential members who are interested in crimes against property. If they include crimes against property, shall they also include white-collar crimes? To ignore such crime would be hypocritical, but to include it could reduce the thrust of the organization. What about victimless crimes? Some may feel that these constitute an unnecessary drain on police resources, but to exclude such crimes runs the risk of losing church support. However, if victimless crimes are included in the goals of the organization, what attention shall be given to potential police graft surrounding such crimes? Yet if the organization concerns itself with police graft, it runs the risk of losing police support. And how effective can an anti-crime organization be if it cannot depend on police support. With such potential disagreement on how to define the problem of what type of crimes to eliminate, it becomes impossible to generate and evaluate plans and programs meaningfully. (p.34)

How do you go about solving a problem as fague and ill-defined as this? Klein and Weitzenfeld suggest a shift in emphasis, focusing on recognizing that a problem exists, identifying the problem that exists, and using failed solutions in reidentifying the nature of the problem. "A failed solution attempt is an integral part of the problem-solving process. It is possible to gain a more specific characterization of the problem by asking: (1) In what ways did this come close to solving the problem? and (2) Why is this not a solution to the problem?" (p. 39).

Another technique for identifying the problem advocated by Klein and Weitzenfeld as well as Gordon (1971) employs analogous reasoning. The problem solver attempts to classify the problem at hand as similar to a previously encountered problem that has been solved. Similar solutions are then generated and tested.

Of the many techniques advocated for solving problems, probably the most basic is simply to view a problem as a problem and take a systmetic, planful approach to its solution. In studying differences between good and poor students, Bloom and Broder (1950) found that good students tend to view difficult test items as problems to be analyzed and solved, whereas poor students abandoned any test item whose answer was not immediately recalled (see Klein & Weitzenfeld, 1978, p. 38). Teaching students to recognize and systematically attack a problem would be a dramatic boon for many students.

Appropriate Use of Study Strategies

Even if students were well trained in how to apply a large repertoire of study strategies, their knowledge of studying still would be incomplete unless they also knew when to approriately use each of those study strategies. There is no one best study strategy. The effectiveness of a particular study strategy depends upon a number of factors. Some of these factors can be grouped into three categories: desired outcomes, presentation characteristics, and person characteristics.

Desired Outcomes

A particular strategy is not compatible with all desired outcomes. For example, if the desired outcome were to remember a series of items, a memory strategy probably would be more efficient and effective then a problem solving or even a comprehension strategy. Likewise, if the desired outcome were to understand a reading passage, a memory strategy such as the loci system would not work as well as a comprehension strategy. Also, within a general

category of study strategies, certain strategies are better for obtaining a desired outcome than others. For instance, if the desired outcome were to be able to retrieve an item in any given position in a memorized list (i.e. the seventh item), both the link and loci systems probably would be inappropriate because they are dependent on sequential retrieval. However, the peg system would be appropriate because it enables direct retrieval of an item.

Presentation Characteristics

Presentation characteristics are variations in the content and representation of the information to be learned. In order for a given study strategy to be beneficial in achieving the desired learning outcome, it is important that the study strategy be appropriately matched to the presentation characteristics. For instance, the results of a research study recently conducted by one of the authors (Wilcox, Richards, Hindmarsh, and Merrill, 1978) suggest that when statements expressing main ideas are made conspicuous in prose text, the study strategy of student generated underlining of main ideas is ineffective. But, when statements expressing main ideas are not conspicuous, student underlining of main ideas significantly facilitates both the student comprehension and recall of the text material. Another example of how presentation characteristics influence the effectiveness of study strategies concerns visualization. There is much research which indicates that mental imagery is only helpful when the information to be learned is concrete or easy to picture. When the information is very abstract, mental imagery may not be a useful study strategy.

Person Characteristics

An individual's age, cognitive abilities and styles, personality attributes, motivation, and a host of other characteristics may substantially affect how well a given study strategy will help him/her to learn. For

example, with regard to visualization, Levin and Pressley (1978) found evidence that children younger than four or six years of age cannot benefit from study strategies which involve mental imagery. Levin (1973) also demonstrated that poor readers who lack necessary prerequisite skills and vocabulary fail to be helped by visualizing what they read. On the other hand, poor readers who do not lack necessary prerequisite skills and vocabulary are aided by visually imagining what they read.

Importance of Knowledge of Studying

Does knowledge of studying really make a difference in the classroom? Research evidence overwhelming indicates that effective use of study strategies improves learning. Bower and Clark (1969), for example, presented students with twelve lists of ten words each over a 30 to 40 minute period. Students who were directed to associate the words through invention of a story remembered 93 percent of the words in their correct order as opposed to only 13 percent for students left to their own resources. Wittrock (1975) reported a study in which randomly selected words were presented in the form of hierarchies. Students who were told to generate hierarchies that "made sense" recalled twice as many words as students who were told merely to copy down the words as they were presented. In another study (Doctorow, Wittrock, and Marks, 1978), children who were asked to write their own sentence describing what they understood after reading each paragraph of a story scored 50 percent better on a comprehension test of the material than children who only read the story. On the problem solving level, Pellegrino and Schadler (1974) merely asked children to plan ahead by verbalizing possible goals and strategies before attempting to solve a problem. Using this simple study strategy, 14 out of 16 children solved the problem. Only 6 out of 16 children not asked to verbalize their plans were successful.

Goldman and Hudson (1973) report some very interesting research regarding study strategies. Students received ability measures and a study strategy questionnaire. The results showed that study strategies were better predictors of GPA than abilities. This lends support to the proposition that study strategies may be more fundamental determinants of academic success than abilities. All of these findings reflect a recurrent theme in the research literature: What students do during instruction strongly influences learning.

Students who can effectively use study strategies also hold the advantage of greater independence. Learners who can only learn effectively when all the information is presented in just the right manner must always rely on the format of instruction to learn. However, if students can adapt to differing presentations, if they can sift through and extract meaning from varied sources, chances for success are greatly heightened. System independence is an important result of gaining knowledge of studying.

As a matter of fact, the whole conception of intelligence has shifted among many theorists. Rather than viewing intelligence as a genetically determined test score, intelligence is increasingly being thought of as a set of problem solving skills, the ability to adapt to and make sense of a given situation where all the information is not given (Resnick, 1977). In accordance with this view, knowledge of studying is an integral part of intelligence.

Teaching Knowledge of Studying

Knowledge of studying usually is slowly and haphazardly inferred from learning experiences. We believe that knowledge of studying would be more speedily and systematically acquired if it were directly taught to students. Such teaching may be done in a separate course or unit, and/or in the context of existing courses or units.

Current efforts in directly teaching knowledge of studying are, in our opinion, inadequate. They are primarily limited to reading and memory improvement classes offered mostly at the college level.

Some of you may be worried that many of the study strategies seem too simple-minded. "I am a good student", you may think, "and I don't use that method". You may be correct. Nevertheless, study strategies usually are reduced to simple procedures so that they can be easily conveyed to students. Through frequent use of simple procedures, students typically will modify the procedures to better suit their individual needs in various situations. This was the finding of Groen and Resnick (1977) who observed that, over a period of time, children who were taught a simple algorithm eventually invented their own algorithms which were as good or better than the one they originally learned.

In many respects, we know very little about knowledge of studying. At this point, we cannot even recommend how you should teach it. Yet, do not let this discourage you. Be your own scientist. Explore different ways of teaching knowledge of studying and monitor the results of this enterprise. Feel free to test study strategies of your own making. Of one thing you can have confidence -- knowledge of studying powerfully affects learning. Therefore, why not attempt to teach it?

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